Diversity of coryneforms found in infections following prosthetic joint insertion and open fractures

von Graevenitz, A ; Frommelt, L ; Pünter-Streit, V ; Funke, G

Abstract: In a 5-year period, 73 coryneform isolates from prosthetic joint and open fracture infections in 60 patients treated in a hospital specialized in orthopedic surgery were speciated. The most frequent species wereCorynebacterium amycolatum, Corynebacterium striatum, Corynebacterium diphtheriae biotypemitis, andCorynebacterium jeikeium. At least 14 isolates were deemed clinically significant as sole agents of infection

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A. von Graevenitz, L. Frommelt, V. Pünter-Streit, G. Funke

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Summary: In a 5-year period, 73 coryneform isolates from prosthetic joint and open fracture infections in 60 patients treated in a hospital specialized in orthopedic surgery were speciated. The most frequent species were *Corynebacterium amycolatum, Corynebacterium striatum, Corynebacterium diphtheriae* biotype *mitis,* and *Corynebacterium jeikeium.* At least 14 isolates were deemed clinically significant as sole agents of infection.

Introduction

Infections following prosthetic joint insertion and open fractures have been reviewed in the immediate past by various authors [e.g., 1–5]. We have been surprised, however, about the paucity of coryneform organisms reported in such infections. The main agents have been coagulase-negative and -positive staphylococci, followed by various streptococci and gram-negative rods [1–5]. A few reports have mentioned "anaerobic corynebacteria" [6] or *Propionibacterium acnes* [4], some have reported non-speciated "diphtheroids" [1, 2], and a few did not find any such bacteria [3, 5]. In our pursuit of infections with coryneforms [7], we thought it worthwhile to speciate a collection of coryneforms that one of us (L. F.) has isolated from those infections since 1992.

Patients and Methods

All patients reviewed had been admitted to the Endo Clinic in Hamburg, Germany, either for an exchange operation necessitated by infection of a prosthetic joint or for correction of an infected open fracture (exogenous osteomyelitis). Generally, a preoperative aspirate was taken from the infected area, material was scraped from the area of infection intraoperatively and postoperatively; drainage fluid was obtained as well. All samples were Gram-stained, inoculated into Brain Heart Infusion (bioMérieux, Marcy l'Etoile, France), TVLS Medium [8], the set of media devised by *Lodenkämper* [9], aerobic (5% CO_2) Columbia blood agar, and anaerobically incubated Brucella Agar, both with 5% sheep blood (bioMérieux). If there was growth in the liquid media [8, 9], they were subcultured to those aerobic and anaerobic blood agar plates as well. Isolates were kept on Brain Heart Infusion (bioMérieux) slants. They were identified as to species by a scheme elaborated by two of us [10]. Susceptibility testing was done by the DIN method [11].

Clinical significance of the isolates was evaluated from the patients' records. All patients showed clear signs of infection as defined in an earlier study [6]. We judged as clearly significant those isolates that were found as monocultures in aspirates (most of these had been positive on direct Gram stains).

Questionable significance was assumed when coryneforms were isolated from scrapings or drains only. Mixed cultures were noted, but were not further evaluated for significance.

Results

In all, 73 isolates were recovered from 60 patients in a 5-year period (Table 1). Fourty-one came from hip infections, 17 from knee infections, and 15 from variously located exogenous osteomyelitides. Fourteen isolates were deemed significant, 16 were deemed to be of questionable significance, and 43 were mixed with staphylococci, streptococci, and/or aerobically or anaerobically growing gram-negative rods.

Since our patients were referred from other hospitals, we were unable to determine whether prostheses previously placed contained antibiotics or not. For the same reason, incubation periods could not be determined with certainty; they varied from a few weeks to 2 years. At the Endo Clinic, no antibiotic prophylaxis was given for exchange operations (which involved antibiotic-impregnated acrylic cement) [6]. Nevertheless, 22 patients had received antibiotics for post-primary infections which we defined as those that were preceded by earlier (primary) ones. There were 39 primary and 34 post-primary infections.

The most frequent species involved was *Corynebacterium amycolatum.* Most isolates of this species were formerly classified as *Corynebacterium xerosis* [7]. This species is frequently multiresistant [7], particularly to those antibiotics often used in orthopedics (clindamycin, aminoglycosides, rifampin, and sometimes also to β-lactam antibiotics). The same may be true for the second most frequent species, *Corynebacterium striatum* [7], except that it is generally susceptible to β-lactams. Also often multiply antibiotic-resistant is the fourth most frequent species, *Corynebacterium jeikeium* [7]. It is interesting to note that all coryneforms isolated from the 22 patients who received preoperative antibiotics were multi-resistant.

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Prof. Dr. *A. von Graevenitz, Verena Pünter-Streit,* Dr. med. *G. Funke,* Institut für Medizinische Mikrobiologie der Universität Zürich, Gloriastr. 30, CH-8028 Zürich, Switzerland; Dr. med. *L. Frommelt,* Mikrobiologisches Labor, Endo-Klinik D-22767 Hamburg, Germany.

Table 1: Coryneform bacteria from orthopedic infections.

Species	Clinically significant[a]						Mixed						Of questionable significance						Total per species
	Hip		Knee		Osteo-myelitis[a]		Hip		Knee		Osteo-myelitis		Hip		Knee		Osteo-myelitis		
	P[b]	PP[b]	P	PP	P	PP	P	PP	P	PP	P	PP	P	PP	P	PP	P	PP	
Corynebacterium[c] *amycolatum*	0	2	0	1	0	0	3	4	1	3	1	3	0	2	0	0	1	1	22
Corynebacterium striatum	2	1	1	0	1	1	3	4	0	1	0	2	1	2	0	0	0	0	19
Corynebacterium diphtheriae	0	0	0	0	0	0	2	1	2	0	1	0	0	0	1	0	0	0	7
Corynebacterium jeikeium	0	1	0	0	0	0	0	1	0	0	1	2	0	0	1	0	0	0	6
Corynebacterium Group G-1	0	0	0	0	0	0	1	0	1	0	0	0	2	0	1	0	0	0	5
Propionibacterium sp.	1	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	5
Corynebacterium sp.[c]	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthrobacter sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Corynebacterium sp.[c]	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Corynebacterium glucuronolyticum	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Dermabacter hominis	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Gordona sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Tsukamurella sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Aureobacterium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Corynebacterium pseudodiphtheriticum	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1

[a] see text; [b] P = primary, PP = post-primary; [c] unable to speciate.

The third most frequent species was, surprisingly, *Corynebacterium diphtheriae*. Although this will be the subject of a separate report, it should be mentioned here that the biotype of all isolates except one *(gravis)* was *mitis*, and that the ribotypes and antibiogram type corresponded to those found earlier in Switzerland [12]. Table 1 also lists further coryneforms, each of which was represented by one isolate only.

Conclusion

The literature on the subject lists only four single reports of coryneform osteomyelitis on the extremities in which species were determined [13–16]. Four further reports are extant on cases of septic arthritis [17–20]. Our report shows that coryneforms are not rare in prosthetic joint infections and post-fracture osteomyelitides and that they may be causative agents in such infections.

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